Patent Application Number: 09/360,582
Attorney Docket Number: MIT.8312

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

On behalf of

Brandon W. **BLACKBURN**

APPELLANT

APPLICATION: 09/360,582 **EXAMINER: J. Mondt**

FILED: July 26, 1999 **GROUP: 3641**

CONFIRMATION: 4382

Title: LIQUID GALLIUM COOLED HIGH POWER NEUTRON SOURCE TARGET

APPELLANT'S BRIEF ON APPEAL

TABLE OF CONTENTS

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FOR:	LIQUID GALLIUM COOLED HIGH POWER NEUTRON SOURCE TARGET		

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313–1450

Sir:

APPEAL BRIEF FOR APPELLANT

This Appeal Brief is being submitted in accordance with the Notice of Appeal being filed concurrently, in connection with the above-identified application.

I. REAL PARTY OF INTEREST

The party of real interest to this appeal is the Assignee, Massachusetts Institute of Technology.

II. RELATED APPEALS AND INTERFERENCES

The Appellant knows of no other pending appeals or interferences that are related to this instant appeal.

III. STATUS OF CLAIMS

Claims 1-8 were originally presented in this application. Claims 2, 3, and 6 have been cancelled without prejudice or disclaimer to the subject matter contained therein. Claims 1, 4, 5, 7, and 8 are pending in this application. Claims 1, 4, 5, 7, and 8 are appealed.

IV. STATUS OF AMENDMENTS

The Appellant submitted a single Response under 37 C.F.R. 1.116 with no amendments. The Appellant has not filed any other Responses and/or Amendments subsequent to the Final Office Action, dated May 12, 2010.

V. SUMMARY OF CLAIMED SUBJECT MATTER

In accordance with 37 C.F.R. 41.37(2)(c)(v), the following are concise explanations of the subject matter defined in the independent claims (1, 5, and 8) involved in this Appeal.

Independent Claim 1

Independent claim 1 recites a method of cooling a low Z target material of a neutron source assembly. The method provides, by using a nozzle submerged in liquid gallium (see, for example, reference 34 of Figure 2 and page 5, line 13, through page 6, line 8, of the originally filed specification), a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the neutron source assembly to cool the low Z target material (see, for example, Figure 2 and page 5, line 13, through page 6, line 8, of the originally filed specification); provides a reservoir of liquid gallium (see, for example,

Figure 6 and page 11, line 20 through page 12, line 2, of the originally filed specification); and pumps the liquid gallium, serially (see, for example, Figure 1 and page 5, lines 13-20, of the originally filed specification), from the reservoir (see, for example, reference 14 of Figure 6 and page 5, lines 13-20, of the originally filed specification), through the nozzle (see, for example, reference 34 of Figure 2 and page 5, line 13, through page 6, line 8, of the originally filed specification), such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger (see, for example, reference 24 of Figure 6 and page 5, lines 13-20, of the originally filed specification) to remove heat from the liquid gallium, and from the heat exchanger to the reservoir (see, for example, Figure 1 and page 5, line 13, through page 6, line 8, of the originally filed specification).

Independent Claim 5

Independent claim 5 recites a neutron source assembly having a liquid cooled target. The neutron source assembly comprises an accelerator based neutron source including a low Z target material that is bombarded by accelerated particles to produce a neutron flux (see, for example, references 30, 32, 33, and 34 of Figure 2 and page 5, line 13, through page 6, line 8, of the originally filed specification), and a cooling system to circulate liquid gallium through the accelerator based neutron source to cool the low Z target material (see, for example, Figure 1 and page 5, lines 13-20, of the originally filed specification).

The cooling system includes a nozzle, the nozzle being submerged in liquid gallium (see, for example, reference 34 of Figure 2 and page 5, line 13, through page 6, line 8, of the originally filed specification), providing a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the accelerator based neutron source.

The cooling system further includes a reservoir of liquid gallium (see, for example, reference 14 of Figure 6 and page 5, lines 13-20, of the originally filed specification), a heat exchanger (see, for example, reference 24 of Figure 6 and page 5, lines 13-20, of the originally filed specification), and means for serially circulating the liquid gallium from the reservoir through the nozzle to impinge upon the surface of the low Z target material within the accelerator based neutron source, from the accelerator based neutron source directly to the heat exchanger,

and from the heat exchanger to the reservoir (see, for example, connections of Figure 1 generally and reference 16 of Figure 1 and page 5, lines 13-20, of the originally filed specification).

Independent Claim 8

Independent claim 8 recites a liquid cooling system for a neutron source assembly. The liquid cooling system for a neutron source assembly comprises a reservoir of liquid gallium (see, for example, reference 14 of Figure 6 and page 5, lines 13-20, of the originally filed specification); a heat exchanger (see, for example, reference 24 of Figure 6 and page 5, lines 13-20, of the originally filed specification); a nozzle, the nozzle being submerged in liquid gallium (see, for example, reference 34 of Figure 2 and page 5, line 13, through page 6, line 8, of the originally filed specification), providing a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of a low Z target material within the neutron source assembly; and means for serially circulating the liquid gallium from the reservoir through the nozzle to impinge upon the surface of the low Z target material within the accelerator based neutron source, from the accelerator based neutron source directly to the heat exchanger, and from the heat exchanger to the reservoir (see, for example, connections of Figure 1 generally and reference 16 of Figure 1 and page 5, lines 13-20, of the originally filed specification).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Rejection of claims 1, 4, 5, and 7 under 35 U.S.C. §103

The issue is whether claims 1, 4, 5, 7 and 8 are patentable over Blackburn et al. ("Development of a High-Power, Water-Cooled Beryllium Target for the Production of Neutrons in a High-Current Tandem Accelerator", CP392 in "Application of Accelerators in Research and Industry", pp. 1293-1296, edited by J.L. Duggan and I.L. Morgan, AIP Press, New York 1997) in view of Lidsky et al. (US Patent 5,784,423) in accordance with 35 U.S.C. §103.

VII. ARGUMENTS

Rejection of Claims 1, 4, 5, 7, and 8 under 35 U.S.C. §103

Claims 1, 4, 5, 7, and 8 have been rejected under 35 U.S.C. §103 as being unpatentable over Blackburn et al. ("Development of a High-Power, Water-Cooled Beryllium Target for the Production of Neutrons in a High-Current Tandem Accelerator", CP392 in "Application of Accelerators in Research and Industry", pp. 1293-1296, edited by J.L. Duggan and I.L. Morgan, AIP Press, New York 1997) in view of Lidsky et al. (US Patent 5,784,423). This rejection is respectfully traversed.

In formulating the rejection, the Examiner alleges that Blackburn et al. teaches a cooling system to circulate a coolant through an accelerator to cool a low Z target material. The Examiner further alleges that Blackburn et al. teaches that the cooling system includes a nozzle, a reservoir of coolant; and a heat exchanger.

However, the Examiner recognizes that Blackburn et al. fails to teach serially circulating the coolant from the reservoir through the nozzle to impinge upon the surface of the low Z target material within the accelerator, from the accelerator **directly** to the heat exchanger, and from the heat exchanger to the reservoir.

To meet these deficiencies in the teachings of Blackburn et al., the Examiner alleges that Lidsky et al. teaches circulating the coolant from the accelerator **directly** to the heat exchanger and from the heat exchanger to the reservoir.

Independent claim 1

Independent claim 1 recites a method of cooling a low Z target material of a neutron source assembly. The method provides, by using a nozzle submerged in liquid gallium, a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the neutron source assembly to cool the low Z target material; provides a reservoir of liquid gallium; and pumps the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly

to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir.

With respect to Blackburn et al., Blackburn et al. illustrates the following:

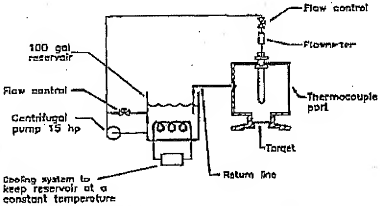

FIGURE 2. Illustration of the complete target cooling system.

As illustrated and taught by Blackburn et al., the coolant leaves the accelerator and is pumped directly into a reservoir, where it is cooled by a cooling system. The cooled coolant, as illustrated and taught by Blackburn et al., is pumped directly back to the accelerator.

In contrast, the presently claimed invention explicitly sets forth that the liquid gallium is serially circulated from the neutron source assembly directly to a heat exchanger. Lastly, the presently claimed invention further explicitly sets forth that the liquid gallium is serially circulated from the heat exchanger to the reservoir.

Thus, as recognized by the Examiner, Blackburn et al. fails to teach a heat exchanger, in series with respect to coolant flow, with a reservoir. Moreover, Blackburn et al. fails to teach or suggest the circulation of the coolant from a heat exchanger to a reservoir.

With respect to Lidsky et al., Lidsky et al. discloses (at column 6, line 62 through column 7, line 20) and illustrates (Figure 3) that the liquid gallium leaving a converter (14) is circulated to a heat exchanger (32A), for cooling, and then back to the converter (14). It is respectfully submitted that Lidsky et al. discloses, with respect to Figure 4, that the liquefied Z-material circulates from converter (14) to heat exchanger (32B), for cooling, and then back to converter (14).

In the various embodiments disclosed by Lidsky et al., Lidsky et al. fails to disclose any type of reservoir.

Moreover, the Examiner asserts that it would be obvious, in view of the teachings of Lidsky et al., that a heat exchanger should be downstream of the neutron source and as close as possible.

Contrary to the Examiner's assertion, Lidsky et al. is silent as to the proximity of the heat exchanger to the neutron source. Thus, the Examiner's assertion with respect to the proximity of the heat exchanger to the neutron source is purely speculation.

In addition, the Examiner asserts that it would be obvious, in view of the teachings of Lidsky et al., to circulate the coolant to the heat exchanger directly from the neutron source and from the heat exchanger to a reservoir.

As noted above, Lidsky et al. fails to disclose any type of reservoir, thus, one of ordinary skill in the art could not reasonably look to Lidsky et al. for motivation or suggestion to include a reservoir downstream of a heat exchanger.

Moreover, Blackburn et al. fails to teach a heat exchanger, in series with respect to coolant flow, with a reservoir because Blackburn et al. desires the coolant to be at a constant temperature.

More specifically, Blackburn et al. teaches a desire to have a colder (liquid) coolant to realize a more efficient heat transfer through the utilization of sub-cooling. In the sub-cooling system, Blackburn et al. teaches that the coolant is vaporized in the target chamber and re-liquefied in the reservoir by the cooling system. Thus, Blackburn et al. teaches the use of water as the coolant.

Lidsky et al. fails to teach or suggest sub-cooling. Thus, the system and gallium coolant of Lidsky et al. would not be compatible with the sub-cooling system of Blackburn et al.

Lastly, it is noted that the Honorable Board of Appeals explicitly stated in the Decision, dated March 31, 2010, rendered in the previous appeal for this application that the Examiner failed to establish that the combined teachings of Eggers (US Patent 5,392,319) in view of Lidsky et al. (US Patent 5,784,423), Pias et al. (IEEE Article), and Alger et al. (US Patent 4,141,224) rendered obvious serially circulating the liquid gallium in the system of Eggers from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir.

It is respectfully submitted that the Honorable Board would have recognized that Lidsky et al. taught circulating the liquid gallium in the system of Eggers from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir if the Honorable Board believe this to be so.

Thus, the combination of Blackburn et al. and Lidsky et al. fails to teach or suggest circulating the liquid gallium from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir, as set forth by independent claim 1.

Independent claim 5

Independent claim 5 recites a neutron source assembly having a liquid cooled target. The neutron source assembly comprises an accelerator based neutron source including a low Z target material that is bombarded by accelerated particles to produce a neutron flux, and a cooling system to circulate liquid gallium through the accelerator based neutron source to cool the low Z target material.

The cooling system includes a nozzle, the nozzle being submerged in liquid gallium, providing a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the accelerator based neutron source.

The cooling system further includes a reservoir of liquid gallium, a heat exchanger, and means for serially circulating the liquid gallium from the reservoir through the nozzle to impinge upon the surface of the low Z target material within the accelerator based neutron source, from the accelerator based neutron source directly to the heat exchanger, and from the heat exchanger to the reservoir.

With respect to Blackburn et al., Blackburn et al. illustrates the following:

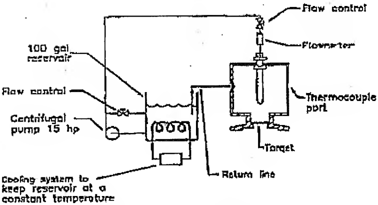

FIGURE 2. Illustration of the complete target cooling system.

As illustrated and taught by Blackburn et al., the coolant leaves the accelerator and is pumped directly into a reservoir, where it is cooled by a cooling system. The cooled coolant, as illustrated and taught by Blackburn et al., is pumped directly back to the accelerator.

In contrast, the presently claimed invention explicitly sets forth that the liquid gallium is serially circulated from the neutron source assembly directly to a heat exchanger. Lastly, the presently claimed invention further explicitly sets forth that the liquid gallium is serially circulated from the heat exchanger to the reservoir.

Thus, as recognized by the Examiner, Blackburn et al. fails to teach a heat exchanger, in series with respect to coolant flow, with a reservoir. Moreover, Blackburn et al. fails to teach or suggest the circulation of the coolant from a heat exchanger to a reservoir.

With respect to Lidsky et al., Lidsky et al. discloses (at column 6, line 62 through column 7, line 20) and illustrates (Figure 3) that the liquid gallium leaving a converter (14) is circulated to a heat exchanger (32A), for cooling, and then back to the converter (14). It is respectfully submitted that Lidsky et al. discloses, with respect to Figure 4, that the liquefied Z-material circulates from converter (14) to heat exchanger (32B), for cooling, and then back to converter (14).

In the various embodiments disclosed by Lidsky et al., Lidsky et al. fails to disclose any type of reservoir.

Moreover, the Examiner asserts that it would be obvious, in view of the teachings of Lidsky et al., that a heat exchanger should be downstream of the neutron source and as close as possible.

Contrary to the Examiner's assertion, Lidsky et al. is silent as to the proximity of the heat exchanger to the neutron source. Thus, the Examiner's assertion with respect to the proximity of the heat exchanger to the neutron source is purely speculation.

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As noted above, Lidsky et al. fails to disclose any type of reservoir, thus, one of ordinary skill in the art could not reasonably look to Lidsky et al. for motivation or suggestion to include a reservoir downstream of a heat exchanger.

Moreover, Blackburn et al. fails to teach a heat exchanger, in series with respect to coolant flow, with a reservoir because Blackburn et al. desires the coolant to be at a constant temperature.

More specifically, Blackburn et al. teaches a desire to have a colder (liquid) coolant to realize a more efficient heat transfer through the utilization of sub-cooling. In the sub-cooling system, Blackburn et al. teaches that the coolant is vaporized in the target chamber and re-liquefied in the reservoir by the cooling system. Thus, Blackburn et al. teaches the use of water as the coolant.

Lidsky et al. fails to teach or suggest sub-cooling. Thus, the system and gallium coolant of Lidsky et al. would not be compatible with the sub-cooling system of Blackburn et al.

In addition, the claim scope of the means for serially circulating the liquid gallium of independent claim 5 is governed by 35 U.S.C. §112, sixth paragraph. 35 U.S.C. §112, sixth paragraph, sets forth that an element in a claim expressed as a means for performing a specified function shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The Examiner has failed to establish how the combined teachings of Blackburn et al. and Lidsky et al. cover the corresponding structure described in the specification and/or equivalents thereof.

Lastly, it is noted that the Honorable Board of Appeals explicitly stated in the Decision, dated March 31, 2010, rendered in the previous appeal for this application that the Examiner failed to establish that the combined teachings of Eggers (US Patent 5,392,319) in view of Lidsky et al. (US Patent 5,784,423), Pias et al. (IEEE Article), and Alger et al. (US Patent 4,141,224) rendered obvious serially circulating the liquid gallium in the system of Eggers from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir.

It is respectfully submitted that the Honorable Board would have recognized that Lidsky et al. taught circulating the liquid gallium in the system of Eggers from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir if the Honorable Board believe this to be so.

Thus, the combination of Blackburn et al. and Lidsky et al. fails to teach or suggest means for circulating the liquid gallium from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir, as set forth by independent claim 5.

Independent claim 8

Independent claim 8 recites a liquid cooling system for a neutron source assembly. The liquid cooling system for a neutron source assembly comprises a reservoir of liquid gallium; a heat exchanger; a nozzle, the nozzle being submerged in liquid gallium, providing a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of a low Z target material within the neutron source assembly; and means for serially circulating the liquid gallium from the reservoir through the nozzle to impinge upon the surface of the low Z target material within the accelerator based neutron source, from the accelerator based neutron source directly to the heat exchanger, and from the heat exchanger to the reservoir.

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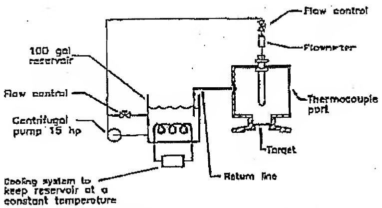

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In the various embodiments disclosed by Lidsky et al., Lidsky et al. fails to disclose any type of reservoir.

Moreover, the Examiner asserts that it would be obvious, in view of the teachings of Lidsky et al., that a heat exchanger should be downstream of the neutron source and as close as possible.

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Lidsky et al. fails to teach or suggest sub-cooling. Thus, the system and gallium coolant of Lidsky et al. would not be compatible with the sub-cooling system of Blackburn et al.

In addition, the claim scope of the means for serially circulating the liquid gallium of independent claim 5 is governed by 35 U.S.C. §112, sixth paragraph. 35 U.S.C. §112, sixth paragraph, sets forth that an element in a claim expressed as a means for performing a specified function shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The Examiner has failed to establish how the combined teachings of Blackburn et al. and Lidsky et al. cover the corresponding structure described in the specification and/or equivalents thereof.

Lastly, it is noted that the Honorable Board of Appeals explicitly stated in the Decision, dated March 31, 2010, rendered in the previous appeal for this application that the Examiner failed to establish that the combined teachings of Eggers (US Patent 5,392,319) in view of Lidsky et al. (US Patent 5,784,423), Pias et al. (IEEE Article), and Alger et al. (US Patent 4,141,224) rendered obvious serially circulating the liquid gallium in the system of Eggers from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir.

It is respectfully submitted that the Honorable Board would have recognized that Lidsky et al. taught circulating the liquid gallium in the system of Eggers from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir if the Honorable Board believe this to be so.

Thus, the combination of Blackburn et al. and Lidsky et al. fails to teach or suggest means for circulating the liquid gallium from the accelerator based neutron source directly to the heat exchanger and from the heat exchanger to the reservoir, as set forth by independent claim 8.

Accordingly, in view of all the reasons set forth above, the Honorable Board is respectfully requested to reconsider and overturn the present rejection under 35 U.S.C. §103.

Conclusion

Accordingly, for all the reasons set forth above, the Honorable Board is respectfully requested to reverse all the outstanding rejections. Also, an early indication of allowability is earnestly solicited.

Respectfully submitted,

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MEC/MJN/mjn

VIII. CLAIMS APPENDIX

1. (Appealed) A method of cooling a low Z target material of a neutron source assembly, comprising:

providing, by using a nozzle, a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the neutron source assembly to cool the low Z target material;

providing a reservoir of liquid gallium; and

pumping the liquid gallium, serially, from the reservoir, through the nozzle, such that the liquid gallium impinges upon the low Z target material in the neutron source assembly and cools the target material, from the neutron source assembly directly to a heat exchanger to remove heat from the liquid gallium, and from the heat exchanger to the reservoir.

4. (Appealed) The method of claim 1, wherein the target material comprises beryllium.

5. (Appealed) A neutron source assembly having a liquid cooled target, comprising:

an accelerator based neutron source including a low Z target material that is bombarded by accelerated particles to produce a neutron flux; and

a cooling system to circulate liquid gallium through said accelerator based neutron source to cool the low Z target material;

said cooling system including a nozzle, said nozzle providing a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of the low Z target material within the accelerator based neutron source;

said cooling system further including,

a reservoir of liquid gallium;

a heat exchanger, and

means for serially circulating said liquid gallium from said reservoir through said nozzle to impinge upon said surface of the low Z target material within said accelerator based neutron source, from said accelerator based neutron source directly to said heat exchanger, and from said heat exchanger to said reservoir.

7. (Appealed) The neutron source assembly of claim 5, wherein said means for circulating comprises a pump.

8. (Appealed) A liquid cooling system for a neutron source assembly, said cooling system comprising:

a reservoir of liquid gallium;

a heat exchanger;

a nozzle, said nozzle providing a submerged jet of concentrated liquid gallium in a direction normal to a non-bombarded surface of a low Z target material within the neutron source assembly; and

means for serially circulating said liquid gallium from said reservoir through said nozzle to impinge upon said surface of the low Z target material within the neutron source assembly, from the neutron source assembly directly to said heat exchanger, and from said heat exchanger to said reservoir.

IX. EVIDENCE APPENDIX

NONE

X. RELATED PROCEEDINGS APPENDIX

NONE